Pixel Layouts

On behalf of many contributors

Pixel General Meeting

October 2, 2000

M. Gilchriese - September 2000

Current Baseline Layout

Barrel						Active	Tilt
	Radius(mm)	Staves	Modules	Chips	Channels	Area(m^2)	Angle(^{o})
B-layer	50.5	22	286	4576	1.76E+07	0.28	-19
Layer 1	93.0	40	520	8320	2.40E+07	0.49	-17.5
Layer 2	127.0	56	728	11648	3.35E+07	0.68	-17.5
Subtotal		118	1534	24544	7.51E+07	1.44	

Disks						Active	
	Inner	Outer					
Z(m)	Radius(mm)	Radius(mm)	Modules	Chips	Channels	Area(m^2)	Sectors
495	121.4	182.2	66	1056	3.04E+06	0.06	11
575	121.4	182.2	66	1056	3.04E+06	0.06	11
640	121.4	182.2	66	1056	3.04E+06	0.06	11
705	99.2	160	54	864	2.49E+06	0.05	9
770	99.2	160	54	864	2.49E+06	0.05	9
Subtotal(Both Sides)			612	9792	2.82E+07	0.57	102
GRAND TOTALS			2146	34336	1.0E+08	2.01	
"FIXED" TOTALS			1860	29760	8.6E+07	1.74	
"INSERTABLE" TOTALS			286	4576	1.8E+07	0.28	

Rapidity Coverage Z=11cm

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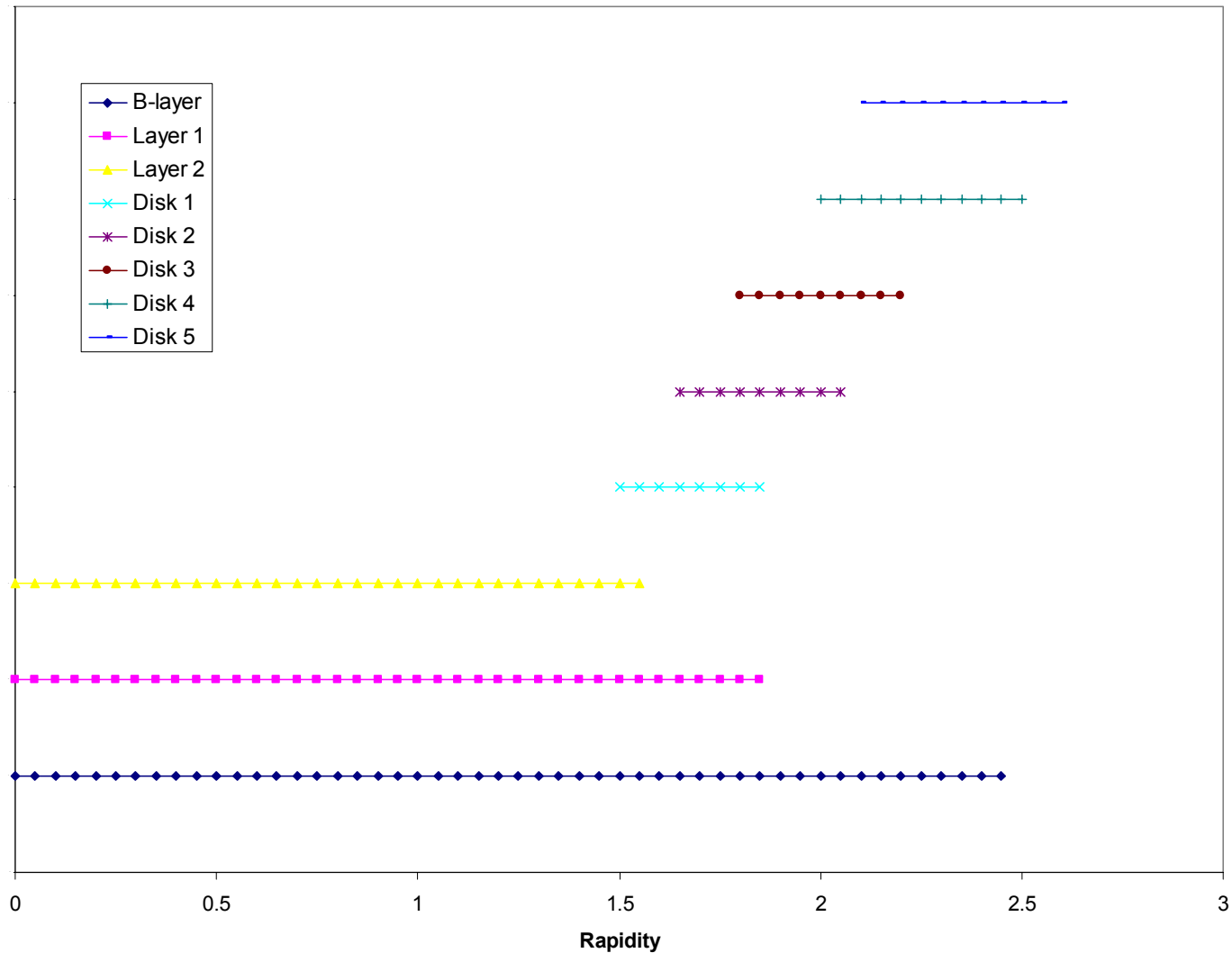
# Baseline Layout
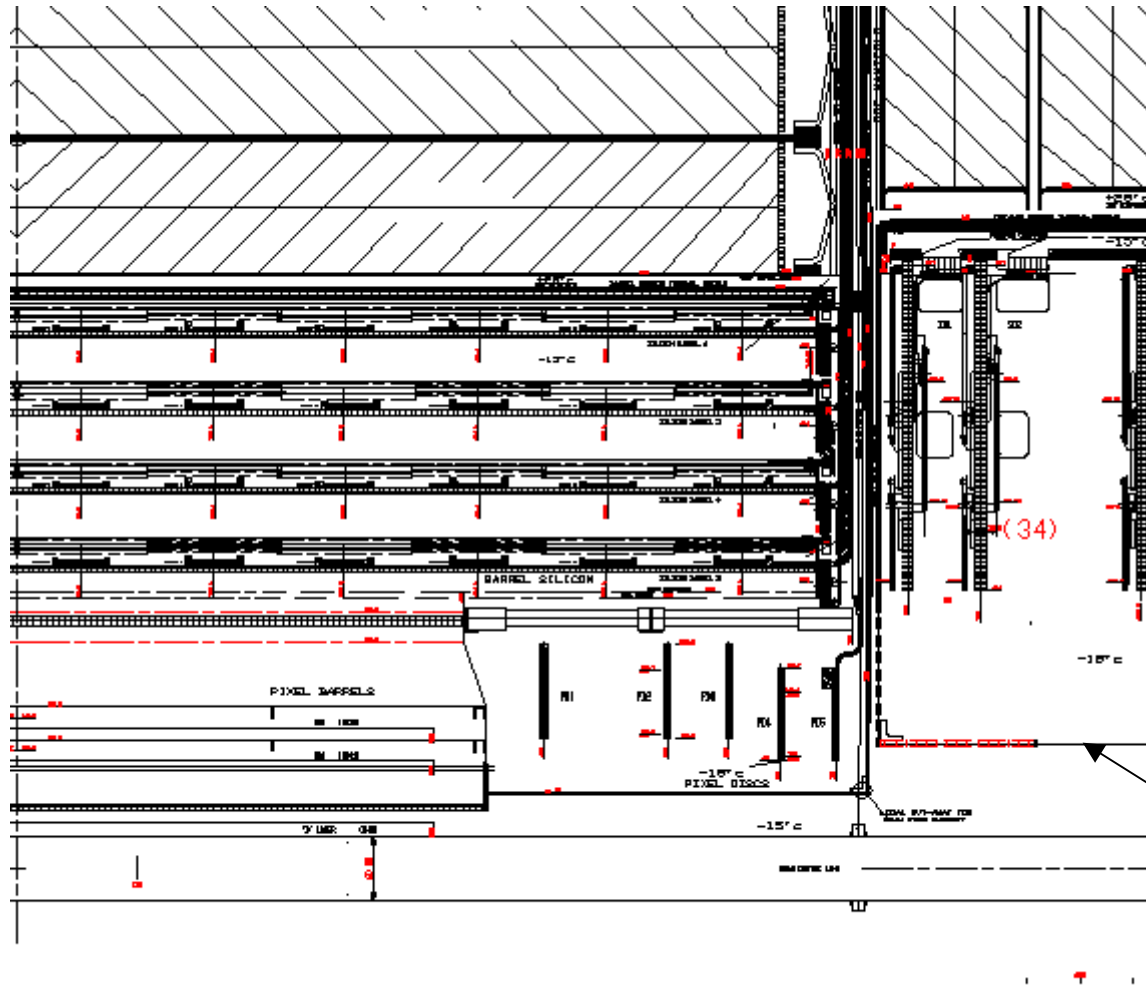
SCT Forward Envelope

Reduced Layout

- To cope with delays in rad-hard electronics and possibilities of other future delays.

- A reduced layout was proposed - see next pages
  - Respected current envelopes, in particular forward SCT bore of R=110mm.
  - Maintains possibility of 3-hit coverage
  - Keeps mechanical design concepts same as baseline
  - But decreases "fixed" part to be inserted into SCT/TRT barrel in Sprin 2004(current schedule) and
  - Increases insertable/removable part - "double B-layer" - that can be installed later(about one year) and removed during short access configuration.

- Proposed at Inner Detector Steering Group(IDSG) meeting on September 7.

- Reaction was to request study of fully-insertable option
  - requires change in SCT envelopes and SCT barrel thermal barrier
  - requires reduction in pixel outer envelope
  - requires modification to pixel installation plan and services routing(services must exit both sides for part of system).

- Preliminary study of this possibility completed and presented here.

Proposed Reduced Layout

Barrel						Active	Tilt
	Radius(mm)	Staves	Modules	Chips	Channels	Area(m^2)	Angle(^{o})
B-layer1	50.5	22	286	4576	1.76E+07	0.28	-19
B-layer2	79.0	34	442	7072	2.72E+07	0.43	-17.5
Layer 2	127.0	56	728	11648	3.35E+07	0.68	-17.5
Subtotal		112	1456	23296	7.83E+07	1.38	

Disks						Active	
	Inner	Outer					
Z(m)	Radius(mm)	Radius(mm)	Modules	Chips	Channels	Area(m^2)	Sectors
515	121.4	182.2	66	1056	3.04E+06	0.06	11
700	121.4	182.2	66	1056	3.04E+06	0.06	11
770	121.4	182.2	66	1056	3.04E+06	0.06	11
Subtotal(Both Sides)			396	6336	1.82E+07	0.37	66
GRAND TOTALS			1852	29632	9.7E+07	1.75	
"FIXED" TOTALS			1124	17984	5.2E+07	1.05	
"INSERTABLE" TOTALS			728	11648	4.5E+07	0.70	

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Reduced Layout - Barrel End View
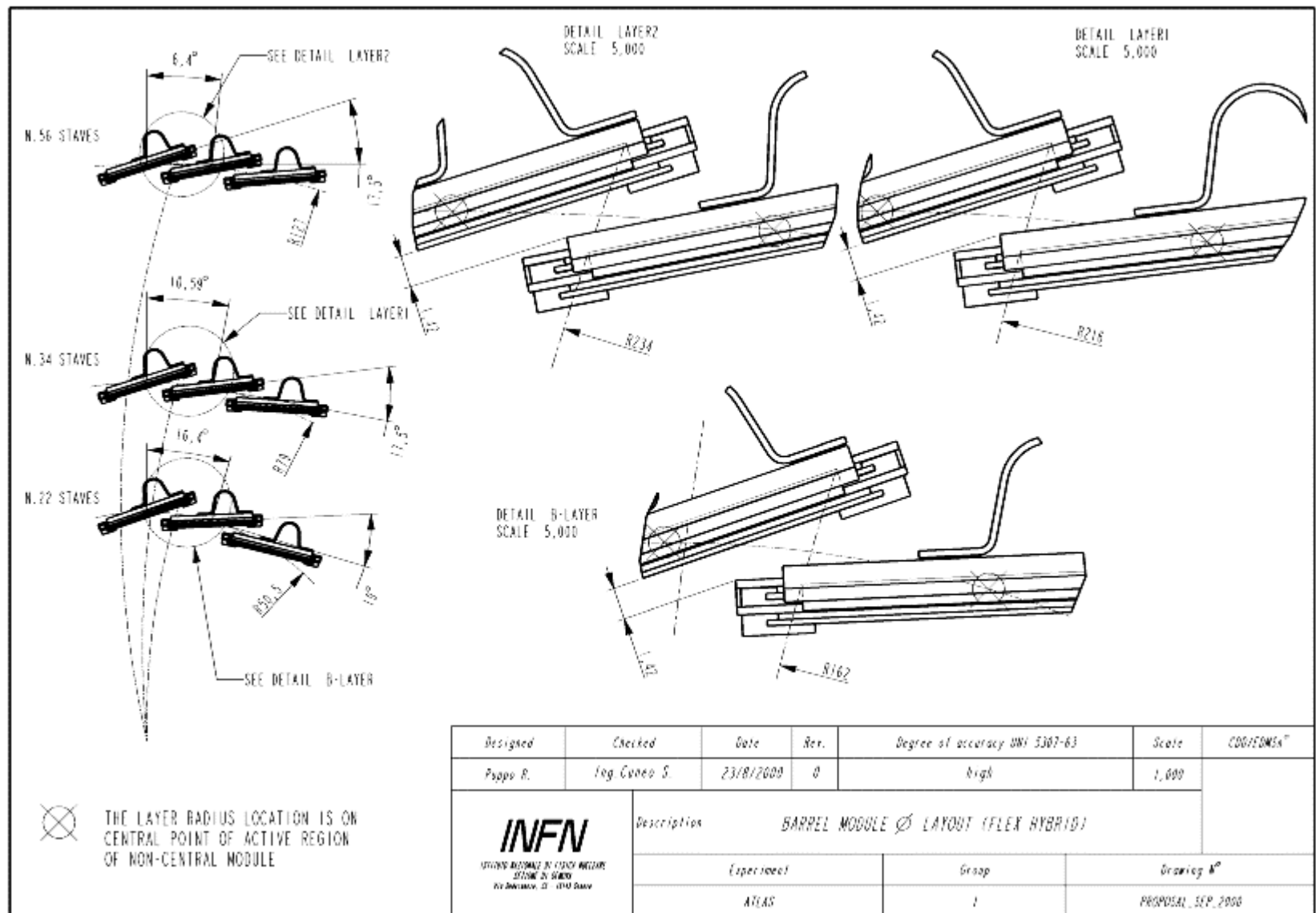
Reduced Layout - Side View

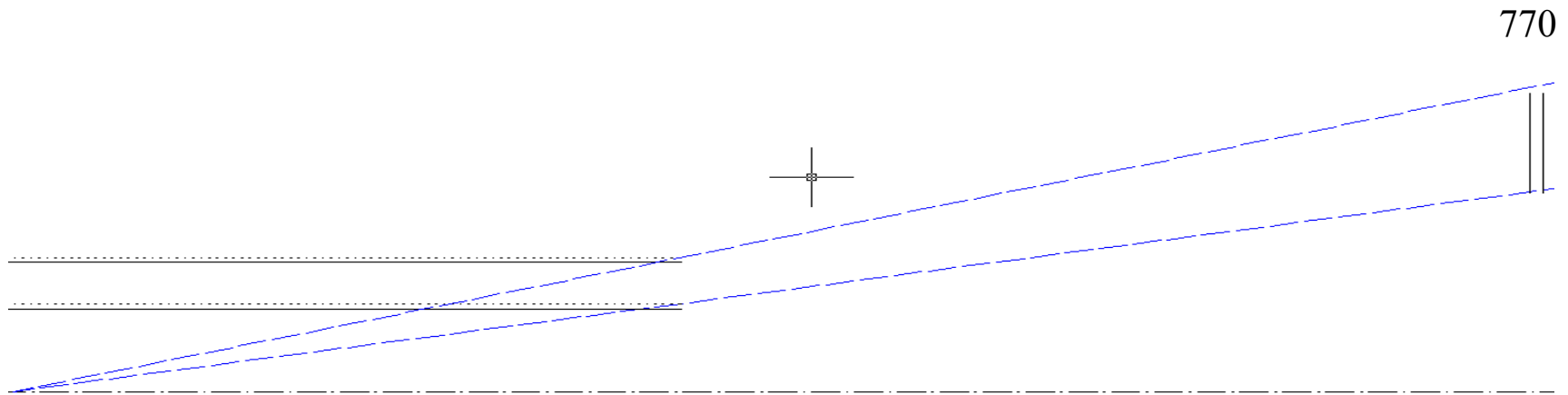M. Gilchriese - September 2000
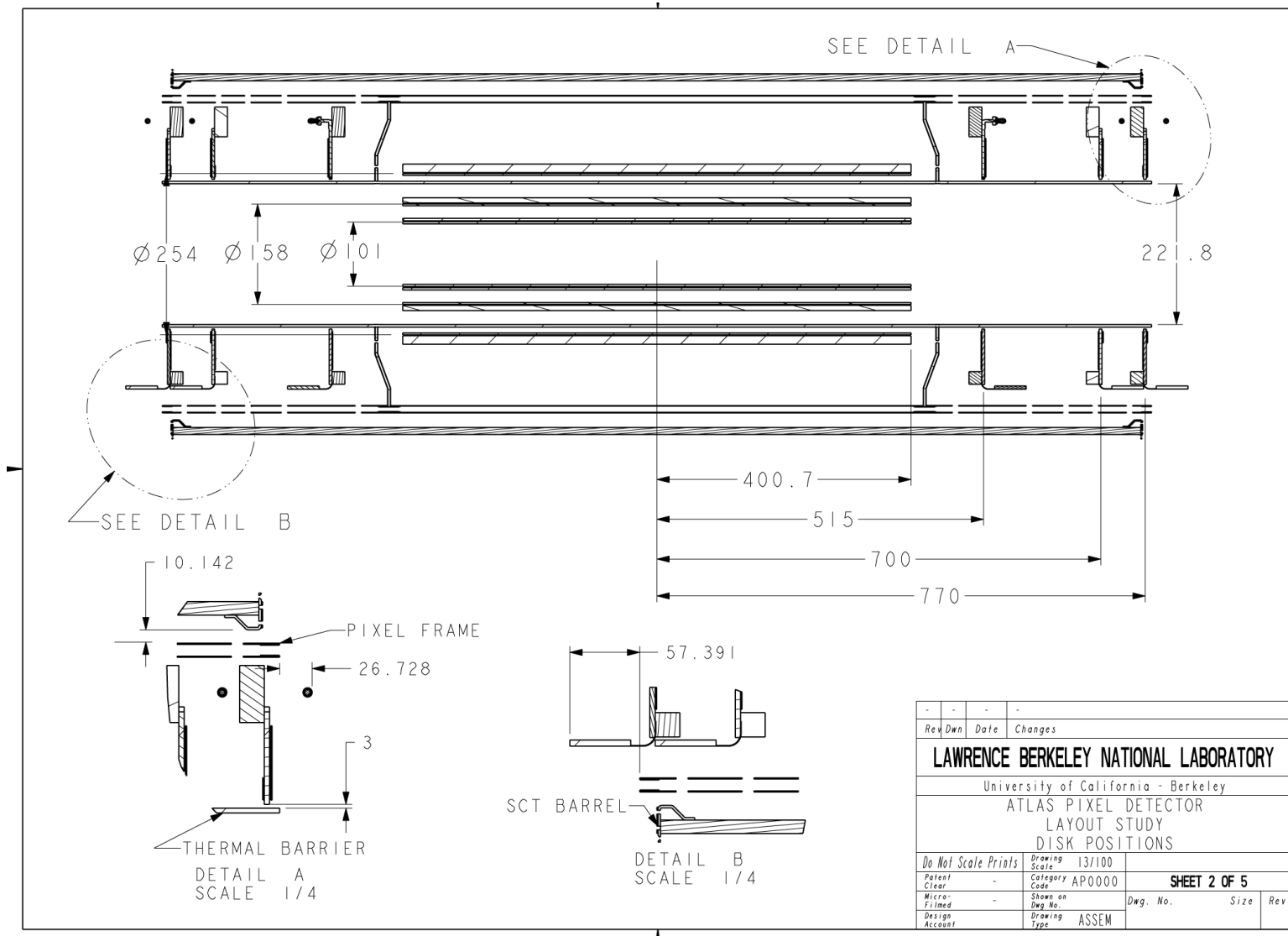
Rapidity
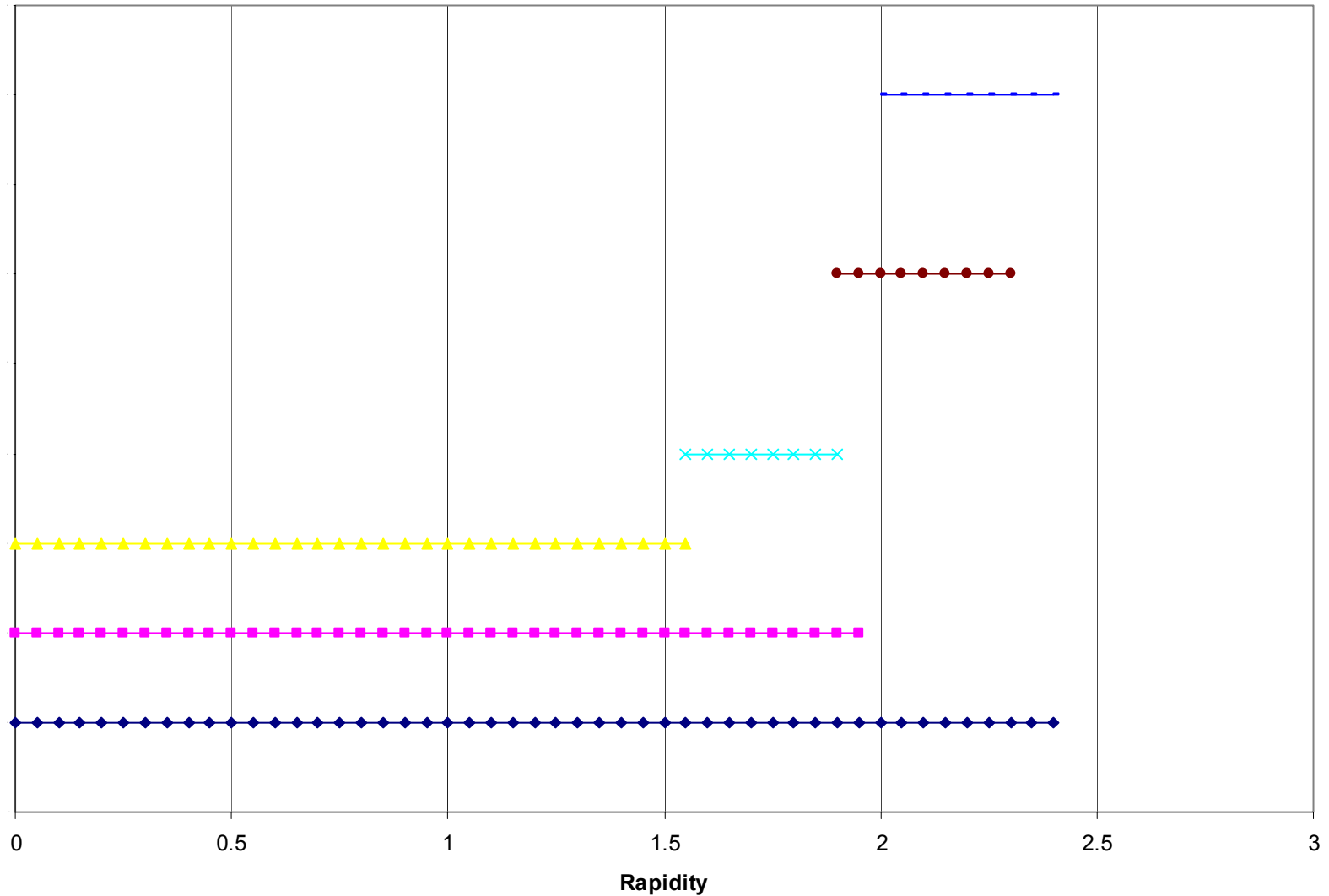
Material
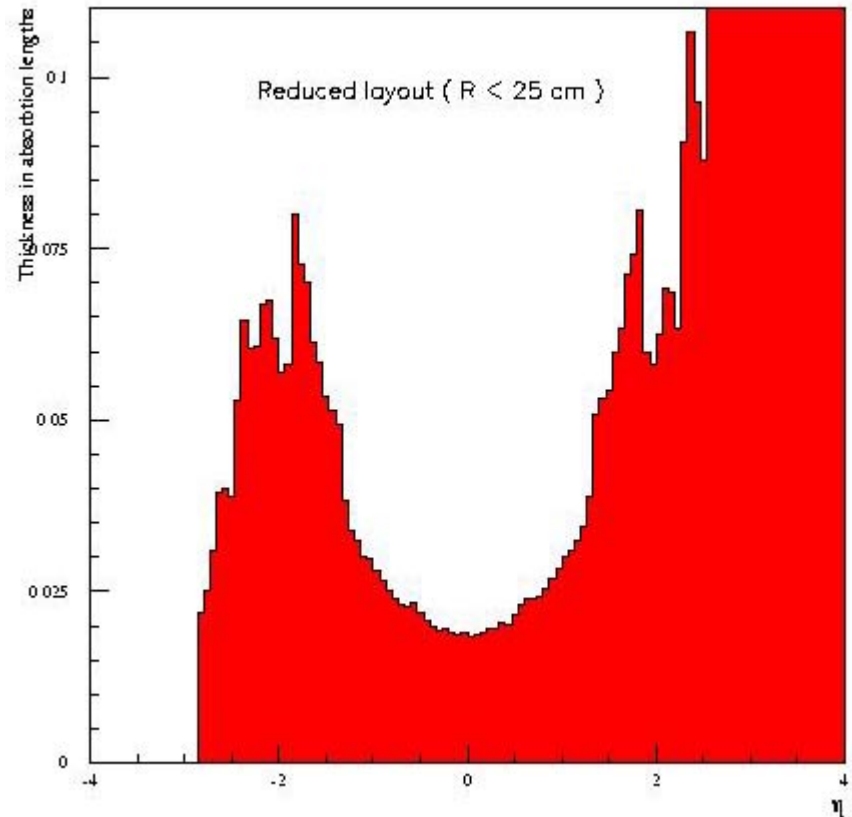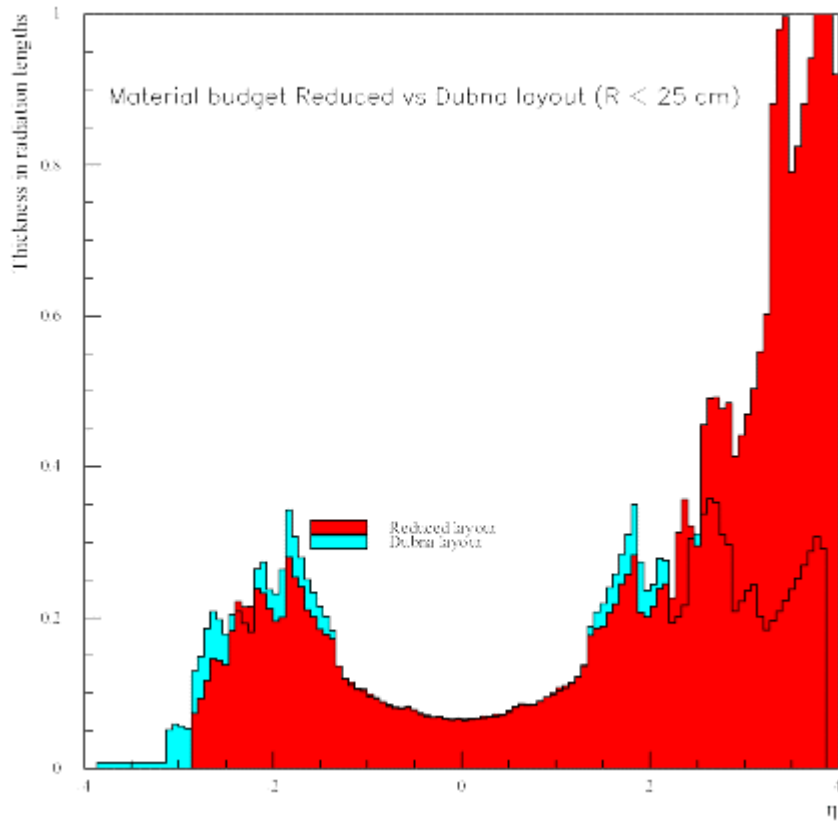
Minimal, 2-hit Fallback

- Continuous black lines: nominal active area
- dotted black lines: largest active area radius

770

Double B-layers + 2x1 disk

Proposal for Insertable Layout

- Clam shell not necessary if beam pipe at end ID is not present
  - Short Access configuration does not allow introduction of anything as large as a full Pixel system to the access volume
  - During initial installation or Long Access configuration liquid argon endcap is pulled back => beam pipe is broken at end of ID.
- Clam shelling of B-layer is only necessary to clear beam pipe flange
- Proposal keeps continuity with current design work
  - Global support frame is not clam-shelled but reduced in radius
  - Staves same and Barrels same in design but different radii
  - Disks must be reduced in radius, number of sectors. Open gaps of about 2.3% and 3.8%, averaged over disk, for 9 and 8 sector disks, respectively.
  - B-layer is the same
  - Module same
  - But non-B-layer services exit both ends….not easy...
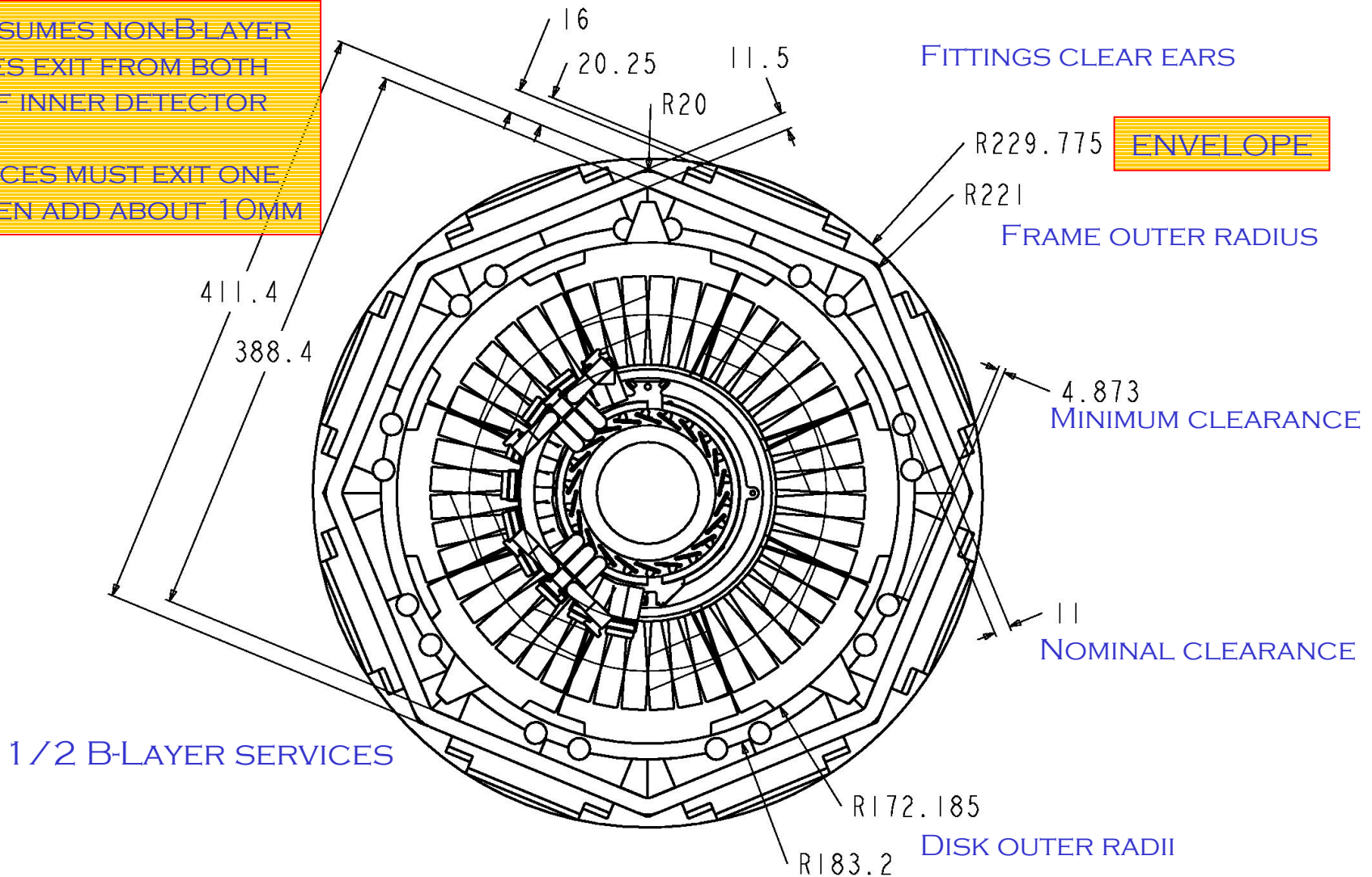
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Insertable Layout

Barrel						Active	Tilt
	Radius(mm)	Staves	Modules	Chips	Channels	Area(m^2)	Angle(^{o})
B-layer	50.5	22	286	4576	1.76E+07	0.28	-19
Layer 1	88.5	38	494	7904	3.04E+07	0.48	-17.5
Layer 2	122.5	54	702	11232	4.31E+07	0.68	-17.5
Subtotal		114	1482	23712	9.11E+07	1.43	

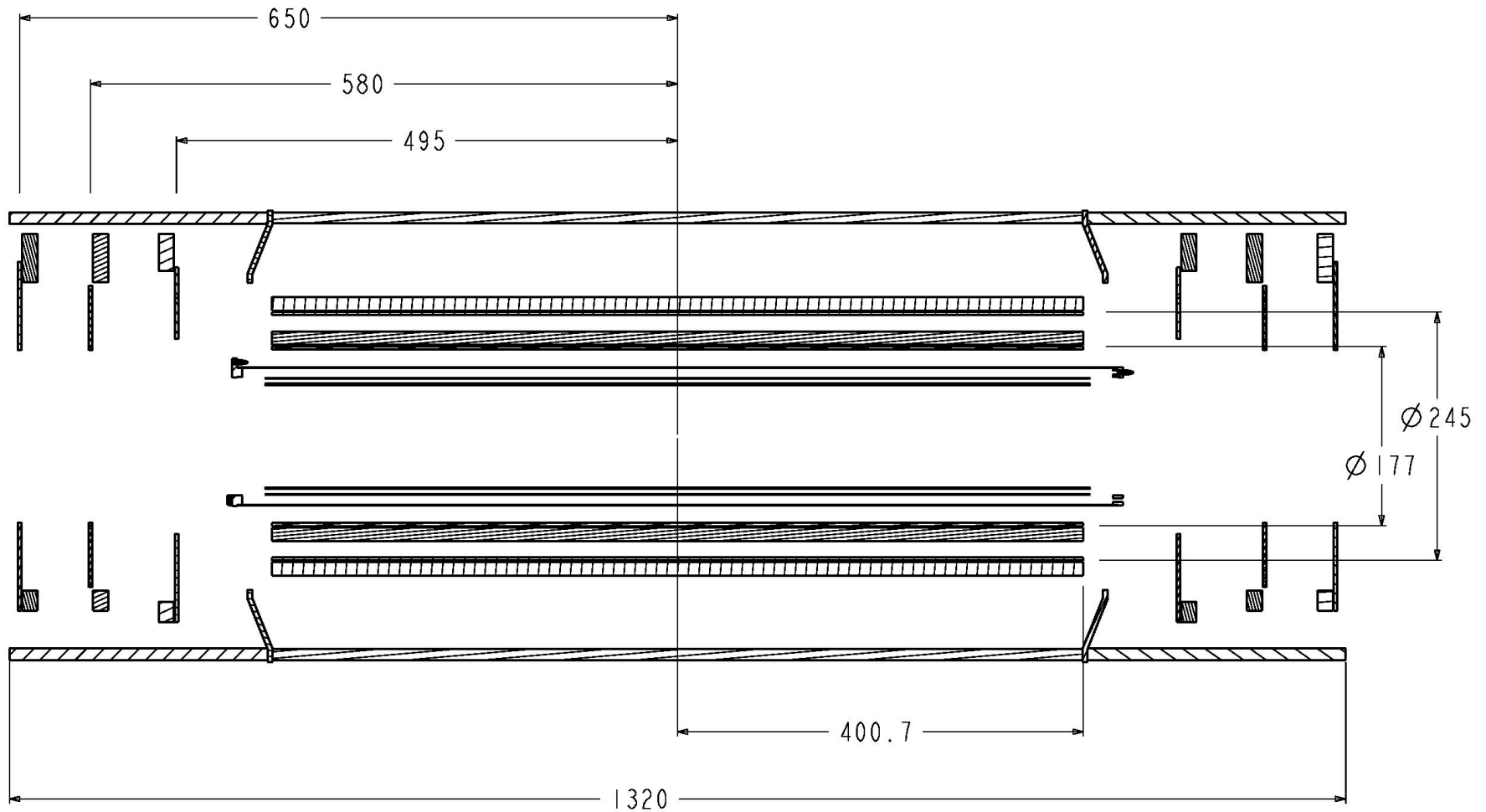| Disks							
	Inner	Outer				Active	
Z(m)	Radius(mm)	Radius(mm)	Modules	Chips	Channels	Area(m^2)	Sectors
495	99.2	160	54	864	2.49E+06	0.05	9
580	88.1	148.9	48	768	2.21E+06	0.04	8
650	88.1	148.9	48	768	2.21E+06	0.04	8
Subtotal(Both Sides)			300	4800	1.38E+07	0.28	50
GRAND TOTALS			1782	28512	1.0E+08	1.71	

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End View

This assumes non-B-layer services exit from both ends of inner detector

if services must exit one side then add about 10mm

16
20.25
11.5
R20
R229.775   ENVELOPE
R221
Fittings clear ears
Frame outer radius
411.4
388.4
4.873
Minimum clearance
11
Nominal clearance
1/2 B-Layer services
R172.185
R183.2
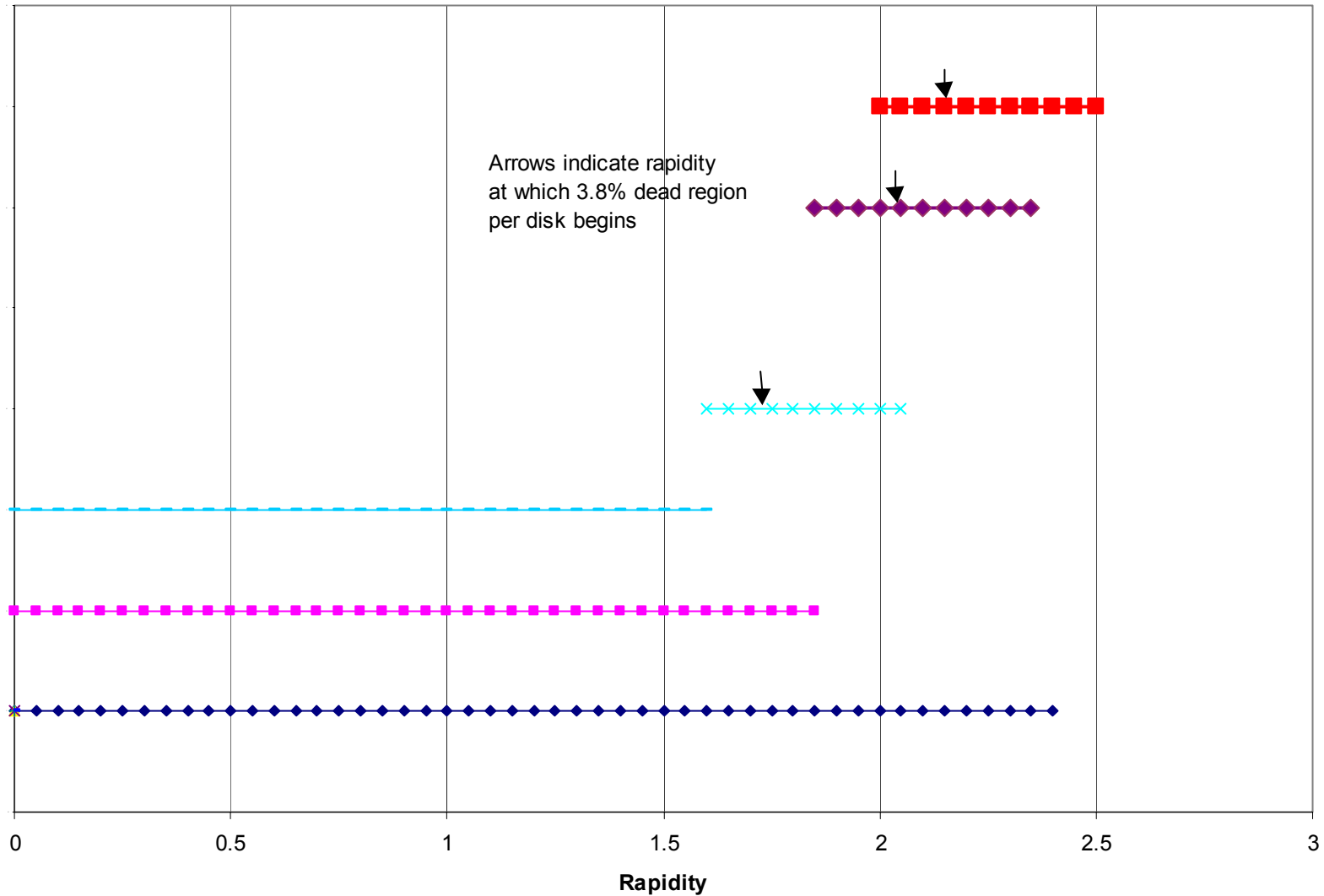Disk outer radii

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Elevation View
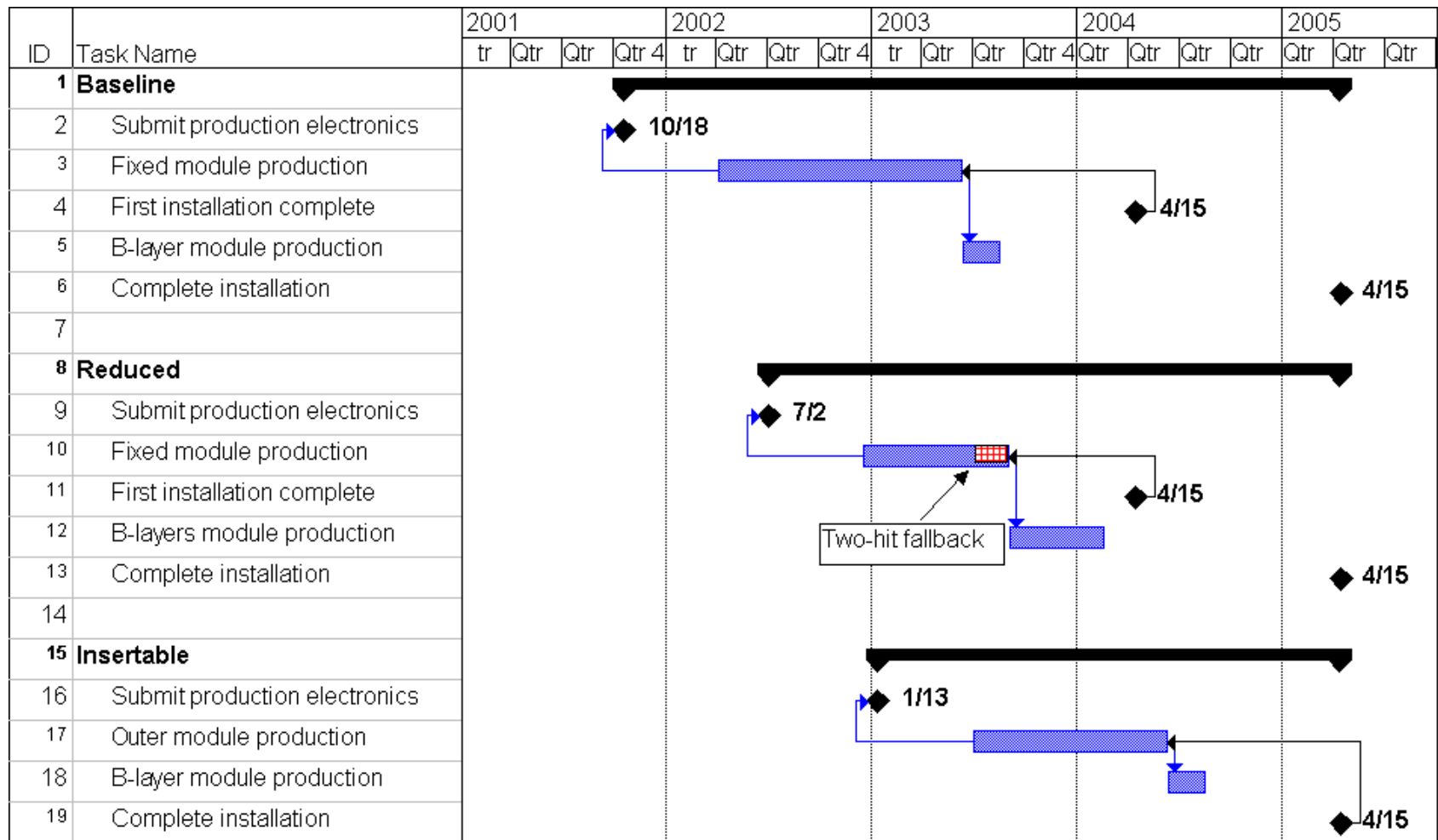
Perspective View
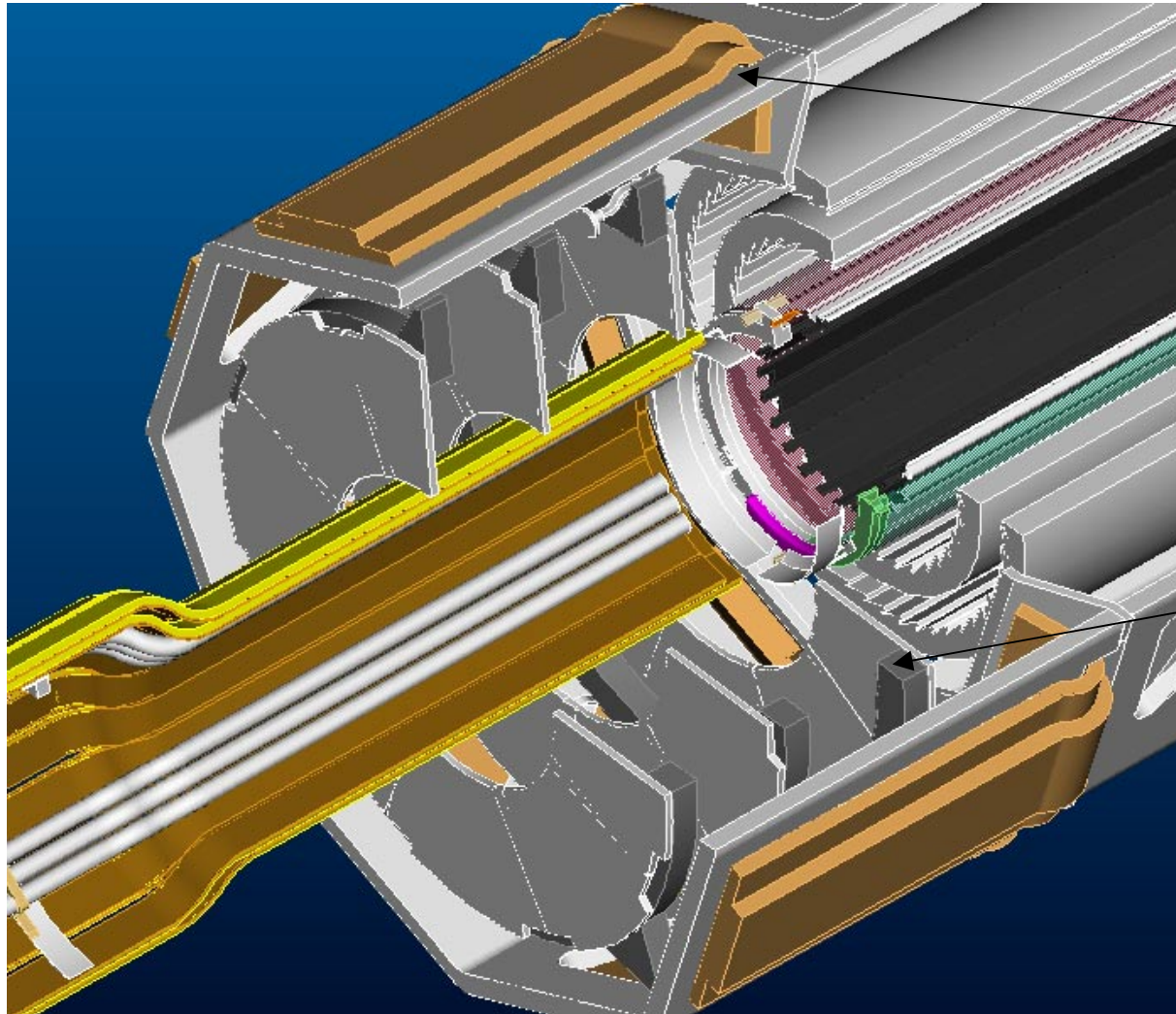
- Barrel Services need to be reduced in width to fit through and on a narrower panel

- Only 4 less staves than in baseline, so 4 octants have the same number of barrel services as baseline but in less space.

- 9-sector disk for first disk to reduce acceptance losses

- Considerable uncertainties remain in services => this is not a conservative layout.

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Coverage Z=11cm

Arrows indicate rapidity
at which 3.8% dead region
per disk begins

Rapidity

Material

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Simplified Schedule Comparison

Assumes 40 modules/week, 75% module yield.

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Schedule Impact on Mechanics

- Rough estimate of impact on mechanics schedule <u>relative to current baseline</u>

- Reduced layout
  - No delay in starting on local supports and global support frame
  - Double B-layer likely more difficult but work just started in any case in this area, long time for design => likely no delay.

- Insertable layout as we propose
  - Depends critically on ability to do quickly joint design of forward SCT thermal barrier and rails to freeze dimensions and acceptance by ATLAS of consequences of insertable system.
  - Considerable uncertainty. (eg. prototyping rail system) may be on critical path for mechanics.
  - Rough estimate is 6 months delay.

- Insertable layout with complete redesign(ie. fully clamshelled)
  - Delay independently estimated by Marco, Eric and Bill to be <u>two years+</u>

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What Ifs for Insertable Layout

- We were asked…what if

- Considerable uncertainty…….need to be prudent...

- Reduce pixel envelope further by 5 mm(from 230 mm to 225 mm)
  - drop 9-sector disk for 8-sector disk. Loss(2 hits rather than 3 hits assuming 100% efficiency) goes from about 0.8% to 2% of tracks.
  - increased risk of violating services envelope

- Reduce pixel envelope by 10 mm(from 230 to 220 mm)
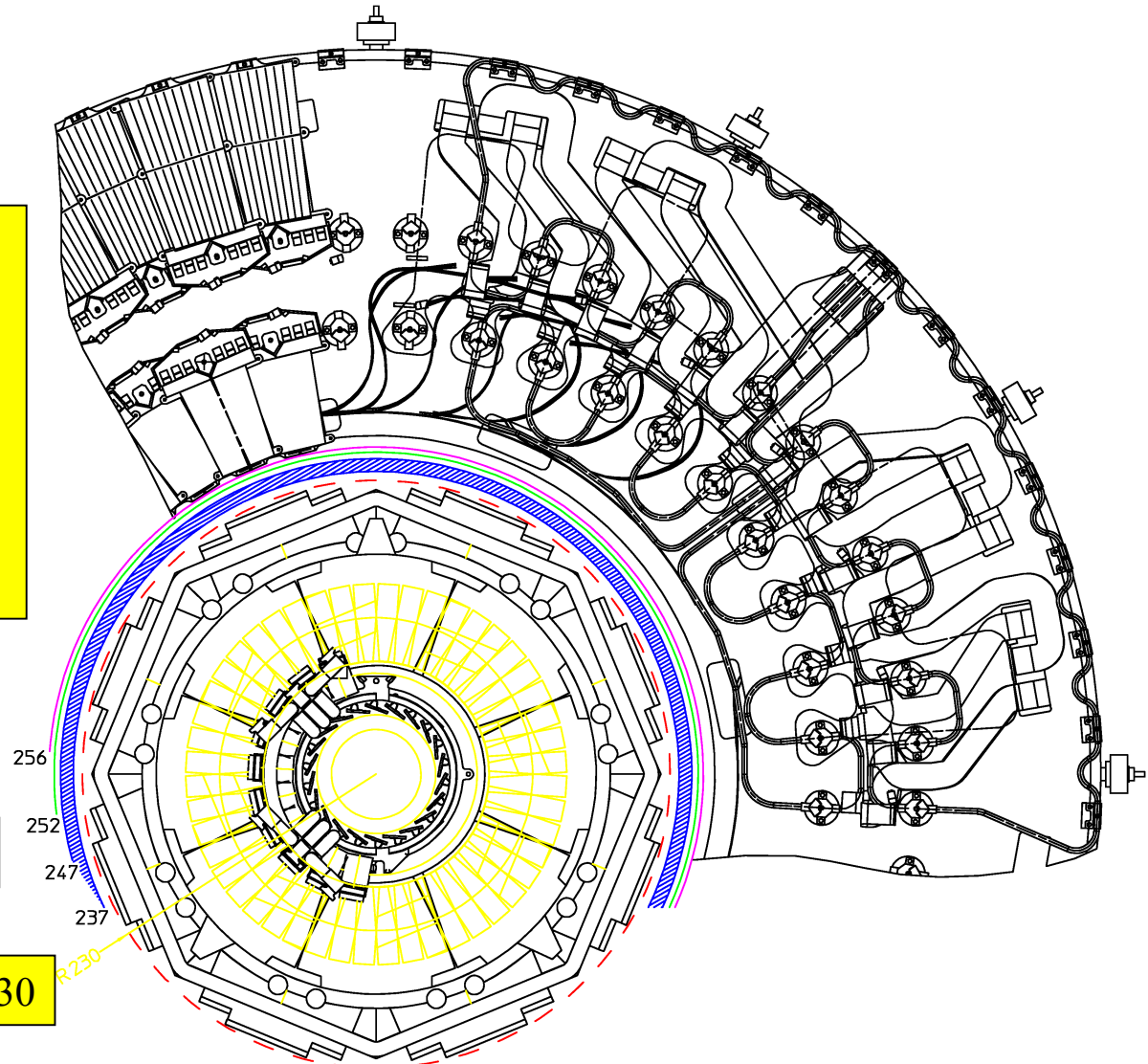 - go to 2 hit layout

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SCT-Pixel Envelope Clash

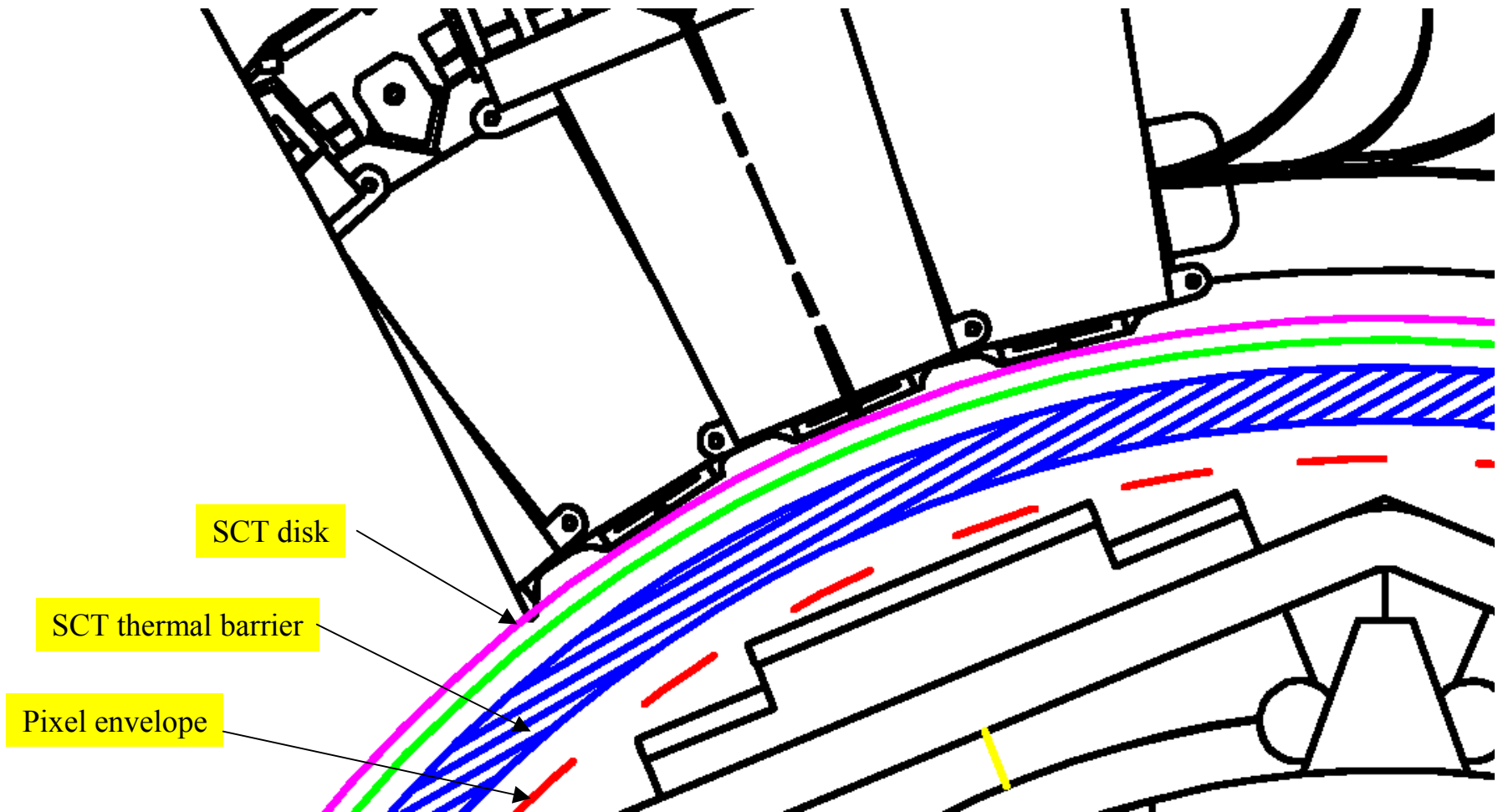Assumption is that 15 mm needed between SCT and Pixel envelopes.

Current SCT and Pixel envelopes clash by about 8mm. Need detailed work to see if this can be solved

SCT envelope R=237

Pixel envelope R=230

256
252
247
237

R 230

SCT-Pixel Envelopes

SCT disk

SCT thermal barrier

Pixel envelope

Possible Choices

A) Reduced layout

- proceed on current schedule for mechanics
- if delay in ICs and later module production => 2-hit layout and major intervention required for 3-hit system or later replacement.

B) Insertable layout as proposed by pixel community

- delay mechanics schedule until SCT/pixel envelopes and impact of services running along SCT bore understood. Delay in mechanics roughly 6 months but uncertain.
- Primary risk is that can't fit with 3 hits => 2 hit system but removable.

C) Other insertable layout

- complete(unknown) redesign. Two-year+ delay in mechanics.
- Not acceptable